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MOLECULAR MECHANISM OF OIL SHALE PYROLYSIS IN NITROGEN AND HYDROGEN ATMOSPHERES

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ABSTRACT

This paper describes the changes in carbon functionality that occur during the pyrolysis and hydropyrolysis of Green River (Colorado) oil shale. This paper is different from earlier work in that shale and product characterization is combined with highly mass-balanced reactions to allow a mechanistic discussion of the role of functionalities in the generation of oil during shale pyrolysis. We identify some important factors in maximizing the conversion of kerogen to oil.

Green River Oil Shale was pyrolyzed under conditions of slow heatup (6°C/min) and short gas residence times (2-10 sec) in a nitrogen or hydrogen atmosphere at 2600 kPa. Product characterization was by elemental analysis, GC, and NMR (solid and liquid).

The aliphatic portion of the shale either cracks to give oil and gas or aromatized to give aromatics in the oil or spent shale. The aromatic portion of the kerogen either cracks to give oil or ends up in the spent shale. Mineral carbonates, rather than organic functionalities, are the source of almost all the CO_2. Hydrogen is effective at inhibiting the reactions which lead to aromatization and formation of residual carbon. Molecular hydrogen in the system also reduces carbonates to methane and water.